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ABSTRACT

The effect of the quantity and location of feedback cues on learning to perform the long jump was assessed. The subjects of this study, none of whom had formal training in jumping techniques, were randomly divided into groups. Each group received different feedback cues at different points in their performance during training. Feedback consisted of training cues given at different strides in the 14-stride approach to the jump. The results of this study indicated that groups receiving not less than one feedback nor more than two feedback cues performed more consistently providing that one of the feedback cues was located at either stride 6 or stride 10. (JD)

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# GROSS MOTOR SKILL PERFORMANCE AS A FUNCTION OF FEEDBACK QUANTITY AND LOCATION

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## INTRODUCTION

There are several principles that are often associated with the learning of motor skills. The principle that practice makes perfect is probably the most widely cited. However, it is important to note that practice alone is not a sufficient condition to enhance learning and performance (Bartlett, 1948). Many authorities agree that practice must be supplemented by knowledge of the outcome of the movement before motor learning will be enhanced (Bell, 1970; Bilodeau, 1966; Drowatzky, 1975; Marteniuk, 1976; Sage, 1971; Singer, 1975). Irion (1966) has suggested that feedback used in the form of knowledge of results (KR) may be the single most important variable influencing motor learning. Feedback is seen as an aid to learning by providing reinforcement, information, or motivation (Adams, 1971; Sage, 1975). It is often difficult to determine whether feedback enhances learning through reinforcement, information, motivation or a combination thereof (Annett, 1969).

Additional studies by Trowbridge and Cason (1932), Elwell and Grindley (1938) and McGuigan (1959) suggested that the level of learning increases as a function of feedback precision. However, the works of Bilodeau (1952), Small (1972), Crafts and Gilbert (1935), and Gill (1975) led to the conclusion that there is an optimal level of feedback precision and that an increase in precision beyond the optimal point will only result in a deterioration of performance. Newell (1977) suggested that task and individual differences may partially determine the optimum feedback level.

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Much of the present knowledge about the impact of feedback on the learning process has been gained through studies involving fine motor activities. In addition, feedback in experimental studies has often been presented verbally, probably because of the difficulty in manipulating visual feedback. The purpose of this study was to determine the relationship of feedback quantity and location to the development of consistency and skill in gross motor skill performance, namely the long jump. The particular intent of the study was to determine if feedback in the form of visual checkmarks during the running approach would improve the consistency of long jumpers in "hitting" the takeoff board.

## METHOD

The main consideration in the study was to assess the effect of the quantity and location of feedback cues on learning a gross motor activity. The long jump was selected because it is a suitable activity to meet the aims of the study. This chapter will describe the subjects, the task, the feedback conditions, and the statistical analyses employed.

### Subjects

The subjects included 28 males and 24 females ranging in age from 18 years to 34 years. All subjects were volunteers and enrolled at the University of Toledo during the Spring Quarter of 1977. None of the subjects had any formal training in long jumping techniques beyond that which a few received in high school physical education classes. All subjects were randomly assigned to one of seven feedback groups.

### Task

The running long jump was the task used to assess the role of feedback quantity and location in gross motor skill performance. A standard long jumping

Task (cont.)

facility with a rubberized asphalt runway 140 feet in length was used. The takeoff board was 8 inches wide and 42 inches long and was located 10 feet from the front edge of the sand-filled landing pit.

All jumps were measured to the nearest lesser 1/4 inch. The final jumps were also filmed with a super 8 movie camera. The error measurements were done by hand to serve as a substitute measure in the event of camera failure.

The checkmarks used along the edge of the runway to provide the feedback during the training sessions were white Wiffle balls, 12 inches in circumference.

Procedure

Subjects were randomly assigned to one of seven experimental groups. The groups were distinguished by the number and location of feedback cues (checkmarks) that were made available to them during the experimental training period. The specific make-up of each experimental group is presented in Table 1.

Table 1

Quantity and Location of Feedback Cues for Experimental Groups

| Group | Number of Cues | Stride Location |
|---|---|---|
| 1 | 0 | - |
| 2 | 1 | 2 |
| 3 | 1 | 6 |
| 4 | 1 | 10 |
| 5 | 2 | 2, 6 |
| 6 | 2 | 6, 10 |
| 7 | 3 | 2, 6, 10 |

Procedure (cont.)

All subjects were given basic training in the fundamentals of long jumping technique. Subjects were instructed to use a 14 stride approach (See Figure 1). The mean approach length for all subjects was 76.66 feet. In as much as it is generally considered that a distance of about 25 yards is necessary for a runner to attain top speed (Powell, 1971), the 14 stride approach allowed enough distance for the subjects to reach as near to maximum speed as possible and at the same time avoid any influence of fatigue. The proper starting location for the approach was determine for each individual by having them run from the takeoff board down the runway and reverse the procedure to verify the distance. Checkmark(s) were then established for each subject as they ran through the 14 stride pattern. The initial instruction session was then concluded by having each subject complete two measured jumps.

The long jump training was identical for the subjects in all experimental groups. The training consisted of five practice sessions to be done over a period of ten days. Each practice session required the subject to complete four practice runs through their approach with the aid of the checkmarks at the prescribed locations (See Figure 2).

After all practice sessions were concluded, each subject completed four jumps that were measured and filmed. The subjects were instructed to jump on each of the four trials, even if they felt that they were not going to be close to the takeoff board. Each jump was measured and the distance from the takeoff board was measured as error.

Statistical Analyses

Means and variances of average size of takeoff errors were calculated for the feedback groups. The Cochran test for heterogeneity of variance was employed to determine if the variances were equal.

Statistical Analyses (cont.)

The SPSS program ANOVA for an analysis of covariance was used to analyze the mean performance on the final four jumps for each subject with the mean performance for each subject on the two initial jumps being the covariate. This treatment was selected in an attempt to determine if differences existed among the experimental groups in terms of gains in distance jumped. The SPSS program ONEWAY was used to analyze error scores to determine if differences existed among the experimental groups in terms of errors at takeoff. The Chi square test was used to determine if the number of foul jumps made by the groups was significantly different from that expected by chance. The .05 level of significance was used throughout the study as the criterion for rejecting the null hypotheses of no differences between groups.

RESULTS

The data were analyzed and the following null hypotheses tested at the .05 level of significance:

$Ho_1$: There are no differences among the variances of takeoff errors of the groups trained with different feedback patterns.

$Ho_2$: There are no differences among the average size of takeoff errors of the groups trained with different feedback patterns.

$Ho_3$: There are no differences among the average distances jumped of the groups trained with different feedback patterns.

Takeoff Consistency

A primary concern of this study was to evaluate the effect of feedback cues on consistency in the performance of a gross motor skill. Thus, the variance of average size of takeoff errors was used as a measure of long jumping consistency. The Cochran test was employed to determine if group variances were heterogenous. The obtained C of .5321 ($p < .01$) was significant and resulted in the rejection of the first null hypothesis.

Group means and variances of the average takeoff errors are presented in Table 2.

Table 2

Means and Variances of Average Takeoff Errors in Inches and Number of Foul Jumps by Feedback Groups

| Group | n | Mean | Variance | Fouls |
|---|---|---|---|---|
| None | 6 | 0.00 | 13.28 | 15 |
| Stride 2 | 6 | -5.84 | 49.48 | 7 |
| Stride 6 | 6 | -3.59 | 3.78 | 1 |
| Stride 10 | 6 | -3.32 | 3.75 | 6 |
| Strides 2-6 | 7 | -3.78 | 5.04 | 3 |
| Strides 6-10 | 6 | -1.12 | 3.30 | 5 |
| Strides 2-6-10 | 7 | -2.08 | 14.36 | 10 |

$C = .5321$ $\chi^2 = 19.28$

Takeoff Consistency (cont.)

Table 2 also presents the number of foul jumps made by each group. The resulting $\chi^2$ of 19.28 ($p < .01$) indicates a significant deviation from chance. The two groups having extreme quantities of feedback (none and strides 2-6-10) made the largest number of fouls.

Takeoff Errors

The distance from the foul line that the subject's foot struck on the fourteenth stride was recorded for each jump. The results of the analysis of variance of average size of takeoff errors are presented in Table 3. The failure to obtain a significant F ratio indicates that the experimental training did not result in any differences among groups in average size of takeoff errors. Thus, there was a failure to reject the second null hypothesis.

Table 3

Analysis of Variance of Average Takeoff Errors

| Source | df | MS | F | p |
|---|---|---|---|---|
| Between | 6 | 21.38 | 1.61 | .174 |
| Within | 35 | 13.30 | | |
| Total | 41 | | | |

Jumping Distance

An analysis of covariance with a covariate of distance jumped before training was used to determine if there were significant differences among groups in average distance jumped after the experimental training. A summary of the analysis is presented in Table 4. The resulting F of 593.09 ($p = .001$) indicates that the covariate, initial jumping performance, accounted for the largest portion of the explained variance among the post-training distances of the feedback groups. In line with these results, there was a failure to reject the third null hypothesis.

Jumping Distance (cont.)

Table 4

Analysis of Covariance of Distance Measures

| Source | df | MS | F | p |
|---|---|---|---|---|
| Covariate (Pred) | 1 | 45518.52 | 593.09 | .001 |
| Main Effects (Group) | 6 | 151.78 | 1.98 | .096 |
| Residual | 34 | 86.42 | | |
| Total | 41 | | | |

## SUMMARY AND DISCUSSION

The most substantial findings of this study dealt with variability in takeoff errors. This was reflected by the significant differences obtained among the variances of the average takeoff errors of the groups and by the significant differences obtained among the groups on number of foul jumps. The groups that received visual feedback at stride 6, stride 10, strides 2 and 6, and strides 6 and 10 had smaller variances than the groups receiving feedback at stride 2, strides 2,6, and 10 or no feedback. This finding suggests that at least one but not more than two checkmarks produce the most consistent performance. The extremely large variance for the group receiving feedback at stride 2 further suggests that an early checkmark alone is not helpful. Therefore, an optimal level of feedback precision in terms of both number and location can be implied from analysis of the group variances. The number of foul jumps provides further support for this view in that the no feedback and feedback at strides 2, 6 and 10 groups had the largest number of fouls.

SUMMARY AND DISCUSSION (cont.)

The failure to obtain significant differences among the feedback groups in distance jumped is not a particularly surprising result in that no practice jumps were taken during the study.

Consideration of the group variances and foul jumps indicated that they are in line with the optimal level of precision theory and extend the findings of several earlier feedback precision studies. The results of this study indicated that groups receiving not less than one feedback nor more than two feedback cues performed more consistently providing that one of the feedback cues was located at either stride 6 or stride 10. The number of fouls made by the group receiving no feedback cues and the group receiving feedback cues at strides 2,6, and 10 further supports the optimal level of precision theory in terms of the quantity of feedback.

Consistency is considered critical to the good performance of many gross motor activities. This would especially be true for the long jump. The ability of a long jumper to be consistently close to the takeoff board should result in better jumping performance because the jumper will be more confident of hitting the takeoff board and therefore, be able to give more attention to the act of jumping. In addition, a jumper confident of hitting the takeoff board will be able to maintain a better takeoff position because of less need to look down at the takeoff board. The results of this study suggest that a long jumper would probably benefit the most by working with two checkmarks, one of which should be near the middle of the approach run. Further, these results provide the basis for a more scientific approach to task of determining the quantity and location of checkmarks that should be used by long jumpers and support the non-empirical observations reported by track coaches.

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Figure 1. Experimental long jump stride pattern.

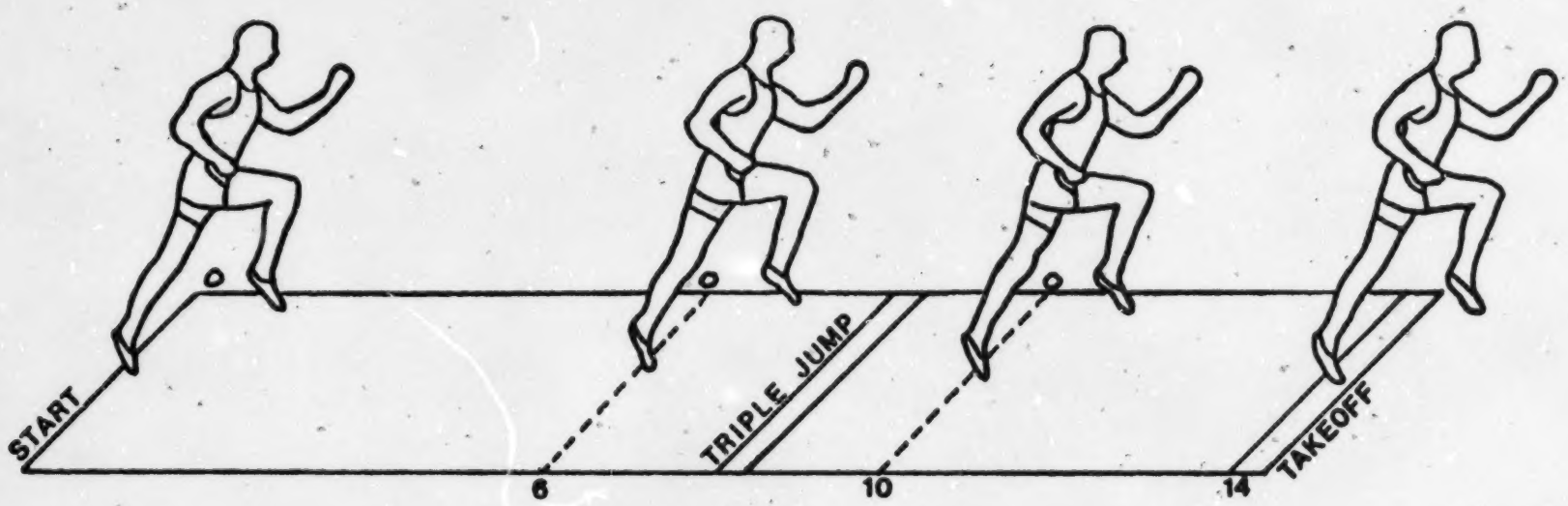


Figure 2. Experimental long jump approach (feedback cues at strides 6 and 10).